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United Arab Emirates, Water Scarcity and Sustainable Agriculture

**The United Arab Emirates: Turning Deserts into Greenhouses**

With modern technology and the third Agricultural Revolution “Green Revolution,” global hunger has seen a reduction of over 34% since 1990 (Opportunity International, 2024). However, that does not mean that this problem has been resolved. It has simply evolved with time. For example, picture a small country about the size of South Carolina, with only 32,300 square miles of land area and 80% of it being desert. Now, add a sea of saltwater to the north and northwest along with mountains lining the east. You would think that a country of that size with such little arable land would equal to high percentages of food insecurity when looking purely at the numbers. But what if that is far from reality in the United Arab Emirates “U.A.E.?” In fact, the U.A.E. has the highest ranking in all the Middle East and North Africa when it comes to food security according to the United Arab Emirates’ Government Portal. However, because the U.A.E. has such little land suitable for agriculture, the majority of their food is imported from other countries. Overall, the main problems affecting food security in the U.A.E. would be the lack of arable land, water scarcity, and desertification. Solutions that could be used for these issues would be implementing the use of greenhouses that utilize salt water to grow crops.

With a total population of 9.97 million people, the typical family in the U.A.E. consists of both parents and two children (CIA, 2024). Gender roles in the U.A.E. have great cultural significance, however, the Emirati Constitution makes sure that they do not interfere with life outside of the home as equal rights for both men and women are guaranteed in the document. Women enjoy the same legal status, access to education, claim to titles, the right to practice professions, and the right to inherit property as men do in the U.A.E. (UAE Embassy, 2024). Residentially, the 87.8% of Emiratis that live in urban areas usually live in apartments, penthouses, bungalows, villas, and duplexes while the other 12.2% that live in rural communities either live in townhomes or traditional tents made of animal hide (House Search, 2023), (Bayut, 2008). Because of this and the fact that the agricultural density of the U.A.E. is 0.72 farmers per acre of arable land, the average family in the U.A.E. does not farm (CIA, 2024). Thus, contributing to the country’s low amount of food production. Because there are very few farms in the U.A.E. and the majority of their food is imported, Emirati families typically buy their food at supermarkets or grocery stores. They also go to local markets and street vendors for more culturally unique ingredients and street foods.

The U.A.E. is a very economically wealthy country, and with a GDP per capita of $74,900 putting them on equal footing with leading western European nations, the people of the United Arab Emirates are very well off (CIA, 2024). This is because the U.A.E. is a major exporter of not only petroleum and crude oil, but also petrochemicals, natural gas, gold, aluminum, and other goods. An example of this “other” category would be the Emirates Airlines airport in Dubai, making billions of dollars annually in profit from international travel alone (CNBC, 2023). In 2022, the U.A.E. exported $105 billion in crude petroleum and produced an average of 3.2 million barrels of petroleum and liquids a day (The Observatory of Economic Complexity, 2024) (International Trade Administration, 2023). However, the amount of money the Emirates’ economy generates from these exports has made the U.A.E. dependent on their sales of oil. This is soon to turn into a major issue for the U.A.E. because the money made from oil production is one of the main reasons why they are able to import 85% of their food costing them 55.1 billion dirhams in 2020 (United Arab Emirates Food and Agriculture Snapshot, 2022) (GRAIN, 2024). Long term, this constant importation of food will not be sustainable for the U.A.E., as many countries across the globe are doing their best to gradually shift from oil-dominant industries to using more renewable energy. An example of this would be the global annual renewable capacity additions increasing by almost 50% to nearly 510 gigawatts (GW) in 2023 (IEA, 2024). As more and more former buyers of the U.A.E.’s oil exports purchase less and less product, the U.A.E. will have to start looking at its expenditures and decide what to cut back on. The best option for the Emirates’ economy would be to start sustainably producing more of their own food.

There are multiple possible solutions to this problem. From implementing community gardens, to greenhouses using saltwater, there are many opportunities for the U.A.E. to start sustainably producing their own food supply. It is all simply a matter of accessibility, implementation, and appropriateness for the people and government of the U.A.E. A major factor that also needs to be considered would be how the ordinary person could also play a role in growing the market of sustainable agriculture in the U.A.E. While major corporations and the Emirates’ agriculture branch have full potential in finding a way to eliminate water scarcity and reduce the importation of food, including the local citizen is what could potentially make or break the efforts being made.

To give a formal definition, a community garden is “any piece of land that is cultivated by a group of people rather than a single family or individual” (Ecolife Editorial Team, 2023). They are a space where anyone, whether they live in that specific community or not, can go to plant whatever they would like, or simply enjoy the variety of plants and produce there. Typically found in urban communities, the most common produce cultivated in community gardens would be things such as carrots, tomatoes, cucumbers, peppers, melons, greens, and even multiple varieties of flowers. While typically very simple, community gardens can cost anywhere from $3,750 to $7,500 to start, going to even $30,000 for particularly large ones (TRUIC, 2024). Time is also a factor to be considered as building troughs to plant things in along with running water pipes through the grounds requires extended periods of time. Because community gardens are run by individual volunteers and members of the community, the aspect of empowering local people to be a part of changing what agriculture looks like in the U.A.E. is perfectly accomplished.

With this community-led program comes a few obstacles to overcome. Water competition for one, would turn into a major difficulty. The U.A.E. has already been in a water shortage for years, as they are a country with extremely arid land. So much so, that in April of 2024, the Emirati government used cloud seeding, which is a weather modification technique that improves a cloud’s ability to produce rain or snow (Desert Research Institute, 2022). While it seemed like a viable option to induce greater rainfall, this completely backfired and caused the whole of the city of Dubai to flood with 5.59 inches of rain in less than 24 hours, more than the whole of the U.A.E. sees annually (The Guardian, 2024). Skyscrapers, apartment complexes, homes, and businesses were completely damaged as the infrastructure in the U.A.E. is made to withstand sandstorms and extreme heat, not downpours of water for over 48 hours straight.

This is all before the fact that the average daily temperature in the U.A.E. is anywhere from 85 – 105°F, making it exceedingly hot for outdoor gardening. Buying the soil, fertilizer, and tools to maintain the garden would also cause issues, as it would be up to the community to fund all expenses themselves. Even with the average family in the U.A.E. making plenty of money to contribute should they feel inclined to do so, over time it could pose a threat to how the gardens are perceived. Instead of being a way to help food insecurity and make the U.A.E. more self-reliant, it could turn into the Emirati people becoming displeased with funding their food sources themselves instead of buying from a market. A major factor yet to be mentioned would be that only a minuscule number of people in the U.A.E. even have a knowledge base of farming. The typical career path in the U.A.E. follows the routes of business, hospitality, engineering, and medicine. Training numerous communities on even the basics of horticulture would prove to be incredibly difficult even if it has a possibility of raising the U.A.E.’s agricultural density in the future.

The best option for the U.A.E. however would be to invest in systems of greenhouses that grow rice using water from the Persian Gulf. This in turn would not only reduce competition between the people and food helping the issue of water scarcity, but would also allow the Emirates to grow one of the main staples of the Emirati diet themselves. Because the agricultural products of the U.A.E. are already eggs, dates, cucumbers, camel milk, goat milk, tomatoes, goat meat, milk, poultry, and camel meat, rice should be the main priority (CIA, 2024). The U.A.E. is also slowly starting to increase the amount of hydroponic gardening that they participate in, so adding greenhouses to the arsenal of possible sources of food for the country is going to be the best long-term solution to not relying on oil sales for money.

Sea rice is a variety of rice developed by agriculturalists to have the ability to be cultivated with salt water instead of fresh water. This is a revolutionary invention, as it allows rice to be grown in typically unfavorable environments lacking access to a body of fresh water. The “Sea Rice” technology as it is called, was first introduced in the year 2000 by a renowned Chinese agricultural expert by the name of Yuan Longping (Future Drive, 2:58). It took Longping a full decade to develop this unique variety of rice that was specially made for desert climates like those found in the U.A.E. Sea rice exhibits incredible tolerance to not only salt but alkali as well, giving the rice better survival skills than ordinary rice varieties (Future Drive, 3:09). With the ability to resist challenges such as high salinity, water logging, pest infestations, and other diseases while maintaining high yields of crop, this was a giant step in the right direction for the U.A.E.’s agriculture (Future Drive, 3:22). However, it’s hard to fully comprehend what this means without a thorough explanation of the obstacles this technology overcame. High salinity or “hyper salinity” is defined as the fact of containing a lot of/too much salt (Cambridge Advanced Learner’s Dictionary and Thesaurus, 2024). Water logging is when something is saturated with or full of water. Agriculturally, this deals with the saturation of soil with water (Oxford University Press, 2024). The fact that a crop like this has not only been created but works so well is a true testament of how far we have come with agricultural innovations in the 21st century.

In 2016, the Emirate of Dubai became aware of the agricultural achievements being accomplished in China, and as the U.A.E. and China have cordial relations with each other, asked for assistance. In response, Longping led a team of experts to Dubai in 2017 to start experimenting with planting in the deserts around the city. While the experiments were working astonishingly, there was a slight problem. The deserts in the U.A.E. are closer to the equator and much more arid than those that were experimented on in China. Dubai’s deserts also have granular sand that is water impermeable, therefore posing a problem in research. However, the Chinese agricultural research team came together to help solve the issue and now there is a swath of green expanses covering 400 square kilometers of land where a barren ten square kilometers used to be (Future Drive, 9:45).

With that being said, receptiveness to the program will be crucial to its success. With the U.A.E. being a hub of innovations and technologies, new ideas are far from foreign to them. The possibility of hundreds of newly available jobs, however, will increase the likelihood of positive reactions and acceptance of the program. On the other hand, there are a few obstacles that may pose a threat to how growing sea rice is perceived. As the U.A.E. is an Islamic state, following proper procedures that are Halal will prove essential in getting not only the citizens but the Emirati government to see this as a viable possibility. Because the U.A.E. is in a perfect spot financially to fund this program, there is also a wide range of possible scales the program can be taken to. The fact that 88% of the U.A.E.’s population consists of migrant workers also makes sea rice a very culturally and economically appropriate solution (Human Rights Watch, 2024). Many of the immigrant workers in the U.A.E. come from South and Southeast Asia along with North Africa and the Middle East. The majority of which, have extensive experience in cultivating rice. This has a major opportunity to be potentially used when educating workers on how to not only operate the greenhouses but also develop the sea rice.

The only thing left to do here would be to slightly modify the work done by Longping in collaboration with Dubai. Growing Sea Rice in greenhouses instead of out on the sand would not only be more efficient by using water that is unable to be consumed by humans and animals, but growing it vertically as some growers do in Singapore to maximize total area would multiply the total yield as well (Eden Green, 2023). The possible crop yield from this could turn out anywhere from 6 to 10 metric tons per hectare. To effectively achieve this however, another country that would have to get involved would be the Netherlands. Deemed the “king” of greenhouses, the Netherlands is home to the greenhouse capital of the world, Westland. Because of the climate in the Netherlands and how far below sea level the country is, they have been refining the art of creating sprawling greenhouses for decades. This allows them to be able to grow any food that they see fit without climate or geographical location causing an issue. The U.A.E. and the Netherlands also share over 50 years of diplomatic relations and have a good relationship with each other, allowing for smooth communication between the two nations to collaborate (Government of the Netherlands, 2023).

Construction of such a large project will not only take time but substantial amounts of money to get started and then maintain. The typical cost of a “regular” commercial greenhouse can be upwards of $25 per square foot. Factoring that into a standard 1,000-foot greenhouse, the absolute minimum for a singular greenhouse will total $25,000 (Prospiant, 2024). Maintenance of an average greenhouse is also quite expensive, as there are numerous components to consider. Irrigation, heating, lighting, HVAC and filtration systems, staffing, and labor are all a part of those costs. For example, a quality HVAC system will regulate the temperature and airflow of a greenhouse. These systems can be installed by units or separated into individual components of heating, ventilation, or air conditioning. A typical HVAC system for a commercial greenhouse can cost $5,000 or more to install. Ventilation fans usually cost $125 on average (Prospiant, 2024). Simply put, the construction of the greenhouses is only a single piece of the puzzle while maintenance is the entire map.

The last part of this program would be training the workers to use this new technology. The very first thing on the agenda would be basic machinery safety along with simple maintenance. Making sure that all workers are knowledgeable in the safety procedures used in large-scale greenhouses will prove extremely important. With such intensive work environments, minimizing any possible faults or injuries should be the priority. Simple maintenance is also a major factor to look at in worker training. If there is a way to teach each and every person working at any of the greenhouses how to do simple procedures like those at a factory line, the need for major repairs will be significantly lowered. As the majority of those working in the greenhouses will be migrant workers, having a lingua franca that will be used on-site would also prove to be useful. The typical migrant worker in the U.A.E. is also from countries that have high amounts of rice production such as South and Southeast Asia along with North Africa and the Middle East. This may also help them when learning to cultivate sea rice as they may already have prior knowledge of how to care for traditional varieties.

To go through with this plan, however, there would have to be a very strategic plan on not only where the greenhouses would be located, but how the water would get from the Gulf all the way to the crops. Given the U.A.E.’s geography, the best place to carve out land for mass placement of greenhouses would be in the Emirate of Abu Dhabi. As this is the Emirate with not only the most total land mass but the biggest swath of desert in the U.A.E., portioning out part of the west quarter of Abu Dhabi would be the most logistically sensible option. Not only is there a straight path to the Persian Gulf in which pipelines could be put in place to run directly into the greenhouses, but there are roads already there that would be able to take the rice into the city to be processed and then shipped out across the country (Nations Online Project, 2024). A project of this size however will need to be authorized and helped along by the Emirati Government. The U.A.E. is run as a Federation of Monarchies, which is a federation of states with a single monarch who is head of the federation while also having lesser monarchs in each various state, which in this case is an Emirate. The autocratic form of government in which the U.A.E. is in requires every single monarch of each Emirate to unanimously agree on this topic, as it involves the whole country and not just the people living in the Emirate of Abu Dhabi. Therefore, getting all the Federal Supreme Council could be an issue when looking at the timeline of getting this project underway.

The impact that this program would have on the Emirati people would not only be creating more jobs for both locals and the migrant workers who account for 88% of the U.A.E.’s population but also reducing competition for water (Human Rights Watch, 2024). By using water from the Persian Gulf this agricultural program eases the concern of clean water for the Emirati people to use in their daily routine. This allows for new ways to fix the Emirates’ current water shortage. Because groundwater is a major resource for the country, the declining groundwater levels pose a risk of running out of supply by 2030 due to increasing agricultural demands (Fanack Water, 2017) (ALJ, 2022). The economic strain from constantly importing food would also see a reduction as one of the main staples of Emirati cuisine would now be able to be grown instead of bought. Rice is also an extremely versatile grain, with a typical shelf life of 30+ years if stored in a sealed, oxygen-free container or bucket in a cool location (Blair, 2023). Therefore, helping food insecurity in the country by bringing in food with a long shelf life that is grown in the country. This allows for there to no longer be a wait time for the food to arrive to the Emirati people as there would be if it had to be shipped from somewhere like South Asia. The crucial aspect of this is the fact that rice has a primary role in the cuisine of the Emirati people. As it is used in any and all meals of the day, a steady supply that is grown within the U.A.E.’s borders will greatly support the Emirati people.

In conclusion, time is of the essence. The longer the U.A.E. waits to sustainably source their own food by relying on imports, the more likely they are going to either lose money or go into a temporary famine. Investing in shifting the Sea Rice campaign that was done with the Chinese agriculturalists into greenhouses is the most efficient solution to both the food insecurity and water scarcity issues of the U.A.E. This is not only because one of the main staples in Emirati cuisine would now start being cultivated inside of the country, but competition between people, plants, and animals for fresh water will decrease.

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